the northwest and on the middle California coast, where it exceeds the cold season in length of time by from 30 to 50 days. The longest cold season is to be found in the southern slope of the Rocky Mountain region, where the cold exceeds the warm season by about 10 days.

The warm season in Texas and the lower Missouri Valley opens about 10 days earlier than in the region near the Atlantic coast south of the lower Lake region, and from 20 to 25 days earlier than on the southern coast of California, while in the northwest it opens from 20 to 25 days earlier than in the Lake region, and from 15 to 20 days earlier than in the northern Pacific coast region.

There does not appear to be such decided differences in the dates of the setting in of the cold season, except along the Pacific coast, where the coincidence of daily normal and annual mean is delayed much later than over the rest of the country.

THE RAINFALL OF THE LEEWARD AND WINDWARD ISLANDS.

By MARK S. W. JEFFERSON, Elmwood, Mass., Submaster Brockton High School.

Mr. Alexander's notes on the rainfall of St. Kitts, W. I., in the MONTHLY WEATHER REVIEW for November, 1900 are of great interest. I am moved to wonder how far the observations given represent the moisture conditions of the island. During a month down and up the Leeward and Windward islands as far as Trinidad, in 1895, with rambles ashore daily, I learned to regard the inner islands, St. Kitts, Nevis, Montserrat, Guadeloupe, etc., to St. Vincent, as heavily wooded mountain summits with abundant rains, due largely to the elevation to which the trades must rise to pass over them. St. Kitts is one of the northernmost and least luxuriant, yet the woods above Basseterre are difficult to penetrate. On the more southern islands the forests are primeval and quite impenetrable. I have before me a number of photographs of these woods as I write, especially in Dominica and St. Kitts, Antigua, and Barbados. On the other hand I recall as dry clear sky islands to the eastward of the main line, without the high peaks and their cloud curtain, and their open woodless country is associated in my mind with lesser altitude.

The inner islands, while rarely thirty miles in length, are all surmounted by peaks well toward a mile in height, and all through the month of March, 1895, showers chased each other across their slopes, or clouds trailed out from their summits. These appearances are abundantly recorded in chance photographs. The rank forest growth forbids the assumption of an unusual month, while the massive stone arches of the highway bridges everywhere, with the peculiar torrent-paving and rainstorm-bridges of Nevis and St. Kitts, imply violent downpours on occasion. I do not know how many of these pavements there may be in St. Kitts, but I stumbled at once on two of them, one at Old Roads, or on the way thither, and the other I have forgotten where. Of the first I have a photograph before me. They are simply portions of the highway paved with stone blocks where mountain torrents pass in time of showers. At the date of my passing they were without water. Two views of rain bridges are in my collection, one at Old Roads, a stone arch ascended by steps at each end, and furnished with a handrail, while a thin stream of water flowed beneath; the other, at Nevis, has steps and round piers of stone with a footway of planks overhead; beneath this no water. I do not remember who told me these bridges were provisions against storms, but I think I was so told, and the fact seemed sufficiently obvious.

Antigua and Barbados, on the contrary, are but 1,300 to to 1,600 feet in height; they are dusty, sunny, and open. Numerous drives assure one that forests either do not exist or are very remote from Georgetown and St. Johns, while there is in both islands a complete absence of that weed tangle, in neglected corners, characteristic of the rain belt. I have supposed that the amount of cooling from expansion induced by this moderate ascent did not induce the trades to give up so much of their moisture. It is my impression that the English regard these two islands as the most agreeable and healthful for residence, not that they are arid but of moderate moisture.

These facts are not at all incompatible with the precipitation figures Mr. Alexander cites, but may, perhaps, be useful to supplement them. What they seem to suggest is that the coastal fringe of plain—an old sea bottom on which Brimstone Hill was a coral reef—receives a rainfall of from 50 to 70 inches, while the mountains above receive a much greater quantity. The constant clouding of Mount Misery compels this belief and all analogy supports it. It is a common defect of rainfall measurements in uneven country that they refer, necessarily, to the low levels inhabited by men. F. H. Newell, in his report on Stream Measurements in 1897, on page 501, cites Cedar River, Washington, as showing:

> A run off of over 102 inches, when compared with the probable precipitation of something over 90 inches at Northbend, which indicates that there must be a considerable increase of precipitation on the mountain slopes, Mr. Noble thinks that the precipitation near the summit of the mountain must be as much as 150 inches a year.

Similarly it is possible that Mount Misery may receive considerably more than 100 inches a year. It will be seen that the steady trades will drive this rainfall toward Brothersons and give to it the greatest precipitation of the island. Similarly the wind tends to keep the mountain downfall away from the east side and diminish its record. For the same reason the west side has nearly as great a fall as the north, the difference being presumably due to the fact that the mountains descend to the southeast of Mount Misery. It is to be noted that the brief record of four months at the Fountain estate, only 800 feet, shows a precipitation twice as great as at Bassetere; also, that the visitor to the summit found the same mist cap there (Table 5) which so impressed me on all these inner islands.

The table of comparative rainfall on four Leeward Islands, on page 488, might convey the idea that Antigua, Nevis, and St. Kitts receive about the same amount of rain. It is my belief that in quantity of water received by the square mile, they are very different. The plants appear to show this. A heavy precipitation on the mountains must of course go to maintain the ground water of the coastal plains and make possible a cultivation that would be difficult without it. The possession of the coastal plain in which St. Kitts differs from Montserrat, Dominica, etc., may give it the advantage for human dwelling of lesser humidity. A complete account of any climate would include necessarily measures of vegetable transpiration, direct evaporation and ground water; and (lacking measures) general statements about plant life may be important qualifiers of rainfall figures.

On reference to Mr. Alexander's note on the great flood of January, 1880, in the REVIEW for May, 1899, I note that although the observers impute the flood to a fall of 20 to 36 inches (estimated) of rain, the authorities who built the wall, like those who constructed torrent pavements and bridges, looked to heavy precipitation on the mountains for their danger.

Hellmann's studies on rainfall measurements about Berlin are suggestive of limits to the dependence to be placed on the St. Kitts gages, yet, the simple prevalence of an easterly wind laden with moisture from the ocean explains admirably the results observed. As the hills east of Basseterre are low, we may group the south and east side as being to windward of low and high mountains, respectively, while the west and north

sides lie in their lee. Ascensional expansion of the air causes cooling and precipitation; the latter which is somewhat greater to leeward than to windward of the crests and greatest beside the greatest altitude, so that the amounts collected fall in the order named. Were the wind always in the east, however, there would seem to be no reason to expect the high windward (east) side to have a smaller precipitation than the low leeward (west) side. The occasional northeast wind, however, makes the east side windward of the west side's ridge.

Perhaps the rains of 1898 that gave a record of 115 inches at Brothersons were accompanied by unusually high winds.

MONTHLY STATEMENT OF AVERAGE WEATHER CONDITIONS FOR FEBRUARY.

By Prof. E. B. GARRIOTT.

The following statements are based on average weather conditions for February, as determined by long series of observations. As the weather of any given February does not conform strictly to the average conditions, the statements can not be considered as forecasts:

February is one of the stormiest months of the year along the transatlantic steamer tracks of the North Atlantic. The storms begin with east to south gales, which, in the case of westward bound steamers, quickly shift to westerly. Ice is rarely encountered as far south as the steamer routes in February, and fog is not frequent over and near the Banks of Newfoundland. In the tropical regions of the Atlantic storms seldom appear in February. On the north coast of western Cuba, however, and over the Gulf of Mexico high north winds, with decided falls in temperature, are not uncommon in February.

In the Atlantic coast districts and the Lake region of the United States the severer storms of February come from the middle-west and southwest. Well-marked storms of this type begin with high northeast winds and snow, and as they progress the wind shifts to west and northwest, with a cold wave. On the Great Plains and in the Rocky Mountain and Plateau districts February weather is usually dry and cold. As during January, however, this entire region is subject to occasional cold waves of great severity, which, with snow and high winds, sweep southward from the British Possessions in the northwest, and sometimes reach the Rio Grande and northern Mexico.

In the Pacific coast districts of the United States the season of rains and occasional strong gales continues through February.

Frost is liable to occur in any part of the United States in February. In the Gulf coast districts and in central and northern Florida the likelihood of severe freezes in February is less than for the preceding month.

THE RELATION BETWEEN THE LEVEL OF GREAT SALT LAKE AND THE RAINFALL.

By SIMON F. MACKIE, dated Salt Lake City, February 20, 1901.

The changes of level during past ages in the lake, whose remnants are known as Great Salt Lake, are matters that have been much studied from a geological point of view. The present paper relates to those changes which have occurred within a recent period and their relation to meteorology.

The drainage basin of this lake, shown in fig. 1, has an area of about fifty-four thousand square miles. How much water enters the lake from, by far, the larger portion of this area, is problematical, for all its visible affluents rise in the Wasatch or Uintah mountains. These affluents are few in number. The Jordan, Weber, and Bear are good sized rivers; Farmington Creek is a small stream; and besides these there are only a few streams from springs near the shores of the lake.

The annual evaporation from a free water surface in this vicinity is placed at about 8 feet per annum. This evaporation takes place from the whole surface of the drainage basin, as well as from the surface of the lake itself, although of course the evaporation from the soil is less than from the lake. Doubtless the rainfall in the mountains is larger than in the valleys; but, other things being equal, the evaporation is also greater. The evaporation from snow or ice is evaporation from a free water surface, as distinguished from soil, and much of the winter snowfall evaporates without melting, so that additional precipitation in the mountains is offset by additional losses.

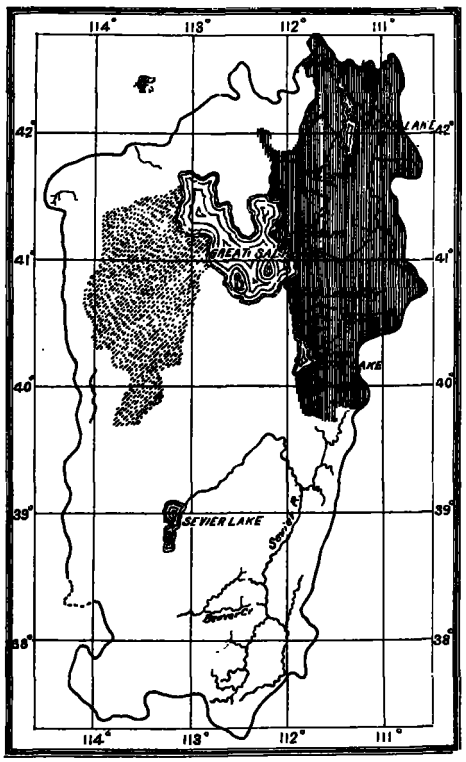

FIG. 1.—Drainage basin. Visible water supply, heavy shading; wet soil in light shading.

The actual drainage basin from which Great Salt Lake receives its visible supply of water is shown by the dotted line in fig. 1. Assuming an available rainfall of 16 inches per annum, it would require an area six times as large as the lake to supply its annual loss by evaporation. But if the visible drainage basin is apparently too small to supply the loss by evaporation, it would possibly be a mistake to suppose that no part of the supply comes from other portions. West of Great Salt Lake there is a tract of country considerably larger than the lake, in which the level of the underground water is, for practical purposes, always at the surface of the soil. This tract, if it is remembered rightly, slopes upward from the shores of the lake, until, at its western limit, it is about 100 feet higher. To the southwest Sevier Lake represents the lowest point of a drainage basin of large extent. Sevier Lake is higher than Great Salt Lake, and from it a tongue of wet soil extends northerly. So far as known, no attempt to map these wet lands has hitherto been made, and in fig. 1 is shown what is believed to be their probable boundary. The problem of the actual sources of the water supply of Great Salt Lake is therefore complex, especially as the wet area to the west receives the drainage of but one or two small mountain streams.

The changes in the volume of water in Great Salt Lake, within the period in which it has been known, are great,